The Merit/NSFNET Project

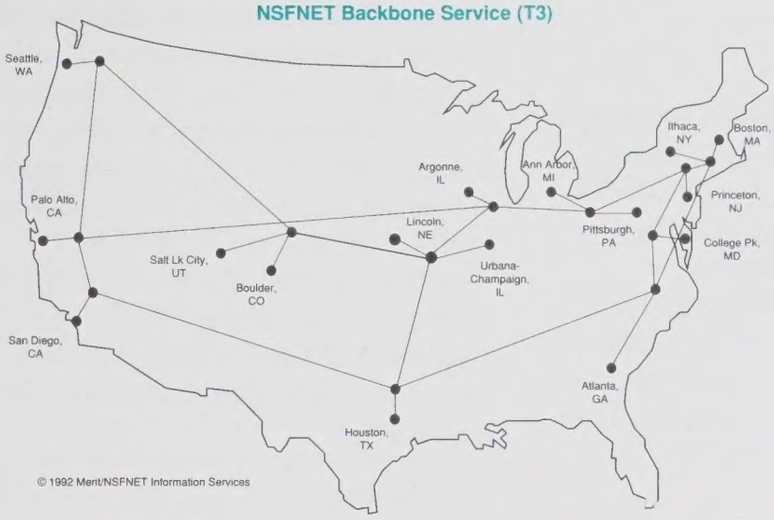
LINK LETTER

T3 Network Nears Full Production

A year of dedication and hard work by the NSFNET partnership has begun to pay dividends for network users as the ANS T3 technology becomes a production tool for NSFNET sites.

As of March 1, a number of midlevel networks were moving their traffic across the T3 network and plans were in place to move the remaining networks over the next few months.

Merit obtains NSFNET backbone services from ANS which provides a major national network that operates at T3 speeds using circuits provided by MCI and central networking technology based on the IBM RS/6000™.



Fine-tuning over the past year

Activities over the past twelve months have focused on installing T3 technology at all NSFNET sites, re-engineering the early T3 backbone to expand total bandwidth and provide greater redundancy, and refining the initial developmental hardware and software to bring the level of reliability up to production standards. In addition, some organizational changes have been made to ensure a smooth problem-solving path.

The first stage is nearly complete and a plan is in place to deploy higher speed T3 interface cards which will increase the throughput on all nodes during second quarter 1992.

Strengthening the architecture

When T3 connections were originally implemented at the beginning of 1991, some problems were experienced with the new architecture. This led to a major effort by Merit, ANS, IBM, and MCI to improve the technology before T3 traffic was increased. Debugging activities continued at a fast pace through October 1991, until a reasonable degree of reliability was achieved.

Peeling the onion

The problem analysis and resolution process has been compared to "peeling the skin of an onion", as multiple glitches that at first appeared to have the same symptoms were

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March/April 1992 — Vol. 5 No. 1

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Odds Favor the User at Upcoming Merit Seminar!

This informative seminar is intended for providers of campus information and administrators, as well as beginning and intermediate network users.

Do you want to learn more about the Internet and the many resources available through NSFNET backbone services? Your opportunity is at hand, as Merit/NSFNET provides another high-quality, information-packed day-and-a-half seminar in Las Vegas, Nevada, on June 1 and 2, 1992.

The revolution in national computer networking continues to affect the way people collaborate in education and research. Hundreds of thousands of educators and researchers are accessing library resources, supercomputers, video applications and the expertise of colleagues around the world through their connections to NSFNET and the Internet.

Who Should Attend:

This informative seminar is intended for providers of campus information and administrators as well as beginning and intermediate network users.

Facilities

The seminar will be held on the campus of the University of Nevada, Las Vegas, in a state-of-the-art facility. Attendees will be able to access remote facilities through NevadaNet and NSFNET.

Lodging

Lodging will be available at the St. Tropez, a non-gaming hotel which is reserving a block of rooms for seminar attendees until May 1, 1992. Make your own room reservations and payment arrangements directly by calling 800-666-5400 or 702-369-1150.

Travel discounts

Special discounted airfares with Northwest Airlines are available for this seminar.

Save with early registration

The registration fee is $295 until May 15, 1992. After May 15 the cost is $345. Limited scholarships are available; contact us today.

The fee includes the one-and-a-half-day seminar, receptions on Sunday and Monday evenings, lunches on Monday and Tuesday, refreshments, the demonstration room, and all seminar materials. For more information on any or all of the above, you may reach us electronically at: **seminar@merit.edu** or by phone at: **1-800-66-MERIT** or **313-936-3000**.

— Merit/NSFNET Information Services

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WAIS—Making it Easier to Access Internet Resources

(Reprinted from *CERFnet News*, Volume 3 Number 6. Used with permission.)

The Wide Area Information Servers (WAIS) system is a set of products supplied by different vendors to help end-users find and retrieve information over networks. Using WAIS (pronounced ways) the user isn't required to become familiar with several different systems. Also, since the interface consolidates data from many sources, the data can be manipulated effortlessly, virtually without regard to their origins.

Thinking Machines, Apple Computer, and Dow Jones initially implemented such a system for use by business executives. These products are becoming more widely available from various companies.

What does WAIS do?

Users on different platforms can access personal, company, and published information from one interface. The information can be anything: text, pictures, voice, or formatted documents. Since a single computer-to-computer protocol is used, information can be stored anywhere on different types of machines. Anyone can use this system since it uses natural language questions to find relevant documents. Relevant documents can be fed back to a server to refine the search. This avoids complicated query languages and vendor specific systems. Successful searches can be automatically run to alert the user when new information becomes available.

Users on different platforms can access personal, company, and published information from one interface.

How does WAIS work?

The servers take a user's question and do their best to find relevant documents. The servers, at this point, do not understand the user's English language question, rather they try to find documents that contain those words and phrases and ranks them based on heuristics. The user interfaces (clients) talk to the servers using an extension to a standard protocol Z39.50. Using a public standard allows vendors to compete with each other, while bypassing the usual proprietary protocol period that slows development. Thinking Machines is giving away an implementation of this standard to help vendors develop clients and servers.

***See WAIS**, following page*

WAIS–Mac Interface Proposed

The latest and greatest from the world of WAIS was demonstrated for attendees at a WAIS seminar held at the MCNC Center for Communications in Research Triangle Park, NC on February 3 and 4.

Participants viewed a number of demonstrations of WAIS software on several platforms and were treated to a sneak preview of an Apple development project to create a new Macintosh-WAIS interface. The prototype of this interface combines graphics and text to present information in a newspaper-like "front page" format.

Speakers at the seminar included meeting organizer George Brett of MCNC, Cliff Lynch of the University of California, Brewster Kahle of Thinking Machines, and Jim Fullton of University of North Carolina–Chapel Hill.

Further information about WAIS may be obtained by contacting George Brett, ghb@concert.net.

—Mark Davis-Craig, Merit/MichNet

Two NASA Sites Connected

"These connections allow scientists to access the very large space and earth science data bases at the Goddard and Ames Research Centers."

Merit has received additional funding under the National Science Foundation cooperative agreement to provide T3 connectivity to two NASA sites, the NASA-Ames Research Center and NASA-Goddard Space Flight Center. These connections, one directly to Ames and a second for Goddard at College Park, were expected to be in place by early March 1992.

"These connections allow scientists to access the very large space and earth science data bases and computational facilities at the Goddard and Ames Research Centers to achieve major breakthroughs in large-scale modelling, simulations, and space mission planning," stated Tony Villasenor, Program Manager for the NASA Science Network. "This is another example of the fine collaboration continuing between the NASA and NSF communities."

—Merit/NSFNET Information Services

***WAIS**, cont. from page 3*

Thinking Machines operates a Connection Machine on the Internet for free use.

Where do WAIS servers exist?

Even though the system is very new, there are already several servers:

- Dow Jones is putting a server on their own DowVision network. This server contains the Wall Street Journal, Barons, and 450 magazines. This is a for-pay server.
- Thinking Machines operates a Connection Machine on the Internet for free use. The databases it supports are some patents, a collection of molecular biology abstracts, a cookbook, and the CIA World Factbook.
- MIT supports a poetry server with a great deal of classical and modern poetry.
- Cosmic is serving descriptions of government software packages.
- The Library of Congress has plans to make their catalog available on the protocol.
- Weather maps and forecasts are made available by Thinking Machines as a repackaging of existing information.
- The "directory of servers" facility is operated by Thinking Machines so that new servers can be easily registered as either for-pay or for-free servers and users can find out about these services.

For more information

Contact Brewster Kahle for more information on the WAIS project, the Connection Machine WAIS system, or the free Mac, Unix Server, and X Window System interfaces. There is a mailing list that has weekly postings on progress and new releases; to subscribe send e-mail to: **wais-discussion-request@think.com**.

You can also retrieve a copy of the WAIS Bibliography by Barbara Lincoln, Thinking Machines, October, 1991. It is available via anonymous FTP from **quake.think.com.** The directory/file is: **/pub/wais/wais-discussion/bibliography.txt** It is also available via the WAIS server **wais-discussion-archive.src**.

Brewster Kahle is the Project Leader for Wide Area Information Servers.

Kahle's Internet-mail address is **brewster@think.com**.

— Brewster Kahle

The T3 Network—What Makes It Tick?

As the migration of all production traffic to the ANS T3 backbone nears completion, performance improvement is the feature that will be most apparent to a majority of users of NSFNET backbone services. However, underlying the visible product is a complex foundation of innovations and advances which reside at the forefront of network technology.

Architecture

The architecture for the T3 network evolved from many observations made in the course of managing the T1 network and is shown in the figure at right.

Packet switches in the T3 infrastructure are designated as either Exterior Nodal Switching Subsystems (ENSSs) or Core Nodal Switching Subsystems (CNSSs). ENSSs are located on the regional network premises and CNSSs are co-located at MCI carrier switching centers which are also known as "points-of-presence" (POPs) or "junction points." The decision to co-locate packet switches within POPs was key for several reasons. Since these locations are major carrier circuit switching centers, they have the full backup power essential to the stability of the network and many are staffed 24 hours/day, 7 days/week.

Additionally, co-locating the CNSSs provides the opportunity to more closely match the carrier-provided circuit switched network topology with packet switched network topology. As a result, path redundancy becomes much easier to engineer.

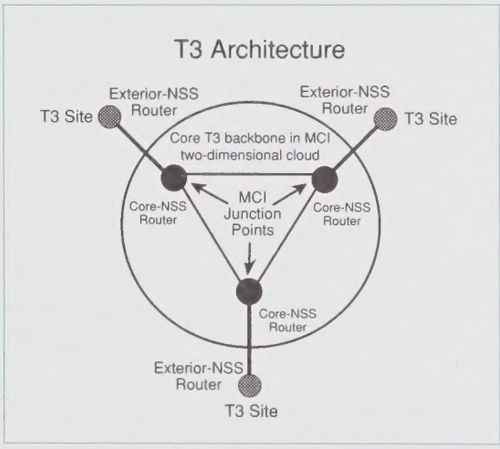
With this architecture, the need for transit traffic to traverse the end nodes is eliminated. Only traffic specifically sourced from or destined to a given ENSS traverses the access link. Consequently, the total bandwidth needs of the CNSS cloud are based on aggregate requirements because of the shared portion of the network while access link needs are based on individual requirements.

Regional network connections

Currently the T3 infrastructure supports both Ethernet and FDDI interconnection. The access into the CNSS cloud is via DS3 (45 Mbs), DS1 (1.544 Mbs) or DS0 (56Kbs) circuits. The network uses cisco™ packet switches for 56 Kbs access into the backbone.

DS3 circuits

The DS3 circuits operate in non-subrated mode, which means that the full 45 Mbs, less framing and carrier management overhead, are available for user traffic. The physical and electrical interfacing to these lines is handled by a Data Service Unit (DSU). Nearly all of the DS3 circuits are carried on terrestrial fiber-optic lines.



Packet switches

The T3 network packet switches are based on the IBM RISC/6000™ machines running code based on the AIX operating system, with appropriate network adapter hardware, and packet switching, routing and network management software. In order to drive the DS3 lines at 45 Mbs, high performance adapter cards and software were required.

To accomplish this, "smart" adapter cards with the Intel 960CA 32-bit microprocessor on board were developed. The cards contain all information required to switch a packet, including routing tables and stored

See T3 Tech, following page

T3 Tech, cont. from page 5

In fact, "smart cards" will switch packets between themselves without any main system intervention.

instruction code for packet switching. In fact, "smart cards" will switch packets between themselves without any main system intervention, thereby greatly increasing packet switching efficiency. CPU intervention is necessary only when routing information is updated. In addition, the presence of a high speed system bus (IBM's Microchannel™) ensures that bus bandwidth will not restrict packet flow. Deployment of these cards at the POP-based CNSS and ENSS sites is being finalized. Completion of this task is expected to take several months.

Routing

The routing technology and architecture used on the T3 network is essentially the same as the T1 network. Routing is fully distributed, with each NSS exchanging state information with other nodes and then computing the optimal routes. The Intermediate System-to-Intermediate System (IS-IS) link state routing protocol is used as the intra-domain routing protocol.

In order to take advantage of the new architecture exterior information is transmitted internally via the Internal Border Gateway Protocol (IBGP).

In order to take advantage of the new architecture and to minimize routing overhead, exterior information is transmitted internally via the Internal Border Gateway Protocol (IBGP). With over 4,500 network numbers in the routing tables maximizing the efficiency and controlling the dynamics of this information transmission assumes paramount importance.

Border Gateway Protocol (BGP) or Exterior Gateway Protocol (EGP) are used as the inter-domain routing protocol, to share reachability and routing information with the attached regional networks. Policy-based routing with tightly controlled routing information flow between attached networks ensures that the T3 infrastructure will continue to serve as the primary transit WAN in the global Internet system.

T1 and T3 co-existence

Since the T3 network was designed as an overlay to complement the existing T1 network and eventually replace it, controlled traffic migration from the T1 to the T3 network posed some challenges.

In the migration phase, which is currently in progress, some sites are connected to both networks, and some to only one. It was essential that a stable and redundant cross-connect system be designed to allow user traffic to reach any site, regardless of how the destination site was connected or where the packet entered the network. Regional networks that were multihomed to both T1 and T3 will maintain peering with both backbones. This will allow the T1 network to be used to connect to regionals connected directly to the T1, and the T3 network to be used to connect to regionals directly connected to the T3. At press time traffic migration was underway and a load sharing configuration was running on the production network.

T1/T3 Interconnect Gateways

The routing design for load sharing involves T1/T3 interconnect gateways at Ann Arbor, Houston, San Diego, and Princeton with 5th and 6th gateways planned at Denver and Seattle. This scheme is integral to maintaining traffic balance and minimizing congestion at the interconnect points.

As 1992 progresses, developers and engineers within the partnership of ANS, Merit, IBM, and MCI will continue to provide a leading-edge environment for the growing number of network users.

—Bilal Chinoy, San Diego Supercomputer Center, and Pat Smith, Merit

Merit Proposals Accepted by CNI

Merit has received word that two proposals, one for an Internet directory project called TopNode, and the other for an Internet Information Packet project, have been accepted by the Coalition for Networked Information (CNI). CNI is a consortium formed by American Research Libraries, CAUSE, and EDUCOM to promote the creation of and access to information resources in networked environments in order to enrich scholarship and to enhance intellectual productivity.

Merit's responsibilities in theTopNode project include sharing knowledge about network resources, assisting in the gathering of such information, and creating an X.500 version of the TopNode directory.

In the other endeavor, Merit will work with CNI to create information packets about networking and the Internet. Participation in this project includes serving as a liaison among the various national networking organizations, the regional networks, and other organizations creating information packets about the Internet. Merit's focus will be on coordination and cooperation rather than rewriting the necessary materials.

If you have any questions about these projects, please contact Laura Kelleher, CNI Project Coordinator, Merit Network at 313-936-3000 or via email at lak@merit.edu

— Laura Kelleher, Merit/NSFNET

Merit's responsibilities in theTopNode project include sharing knowledge about network resources and creating an X.500 version of the TopNode directory.

High-Performance Computing Bill is Law

On December 9, 1991, the High Performance Computing Bill of 1991, known in its various iterations as "The Gore Bill" or "The NREN Bill," was signed into law by President Bush.

"Congressional action on the High Performance Computing and Communications Bill provides strong national recognition of the importance of the national networking effort in which Merit, Inc., has played a pioneering role," commented Dr. Douglas Van Houweling, Merit Board of Directors member and Vice-Provost for Information Technology at the University of Michigan. "The hard work is just now beginning, however, for the expectations of our colleagues and the competition for access are continuing to rise rapidly. Merit will continue to work with the networking community in response to these demands."

Obtaining an electronic copy

Readers may retrieve an electronic copy of the document from the Merit/NSFNET Information Servces server, **nis.nsf.net**, via file transfer protocol (FTP). The file to retrieve is **/internet/legislative.actions/nrenbill.txt**

— Merit/NSFNET Information Services

"The hard work is just now beginning, however, for the expectations of our colleagues and the competition for access are continuing to rise rapidly."

T3 production, cont. from page 1

discovered and fixed. Problems were investigated starting at the circuit level, moving to the DSU or interface hardware, and finally to the router software and hardware.

In recent months, T3 circuit and router deployment has continued at the sixteen NSFNET regional sites with the last of these completed in November. Nevertheless, the phase-in of additional production traffic to the T3 network was delayed because of continuing concerns over reliability and performance of the new technology. These issues have been addressed through a series of actions including:

1) improve the network software and hardware,

2) deploy new monitoring tools to better track problems,

3) provide a fallback system in the event of core node isolation, and

4) develop new test strategies to ensure that the final technology implemented would meet the standards of reliability to which NSFNET users had become accustomed.

New organizational structures have been developed to enhance network operation and improve the interaction with regionals on network problems.

In addition, new organizational structures have been developed to enhance network operation and improve the interaction with regionals on network problems.

Visible improvements

At the top of the stack of visible improvements are performance capabilities which now exceed that of most local networks to which users are attached. The national infrastructure comprises local/campus area networks (local area networks or LANs) connected to the regional and national networks (wide area networks or WANs).

In the past, constraints in performance were generally related to the WANs having slower speeds than the LANs. Many LANs which interconnect to the regional and national networks are Ethernets capable of 10 Mb/sec, much higher than the maximum 1.544 Mb/sec of the T1 networks to which the LANs are attached. In some cases, attachments to campus and other organization LANs have been at speeds of 56 Kbps or less.

Bandwidth limitation now at the local level

Implementation of the T3 infrastructure has produced a setting in which backbone capacity is higher than much of the interconnecting network bandwidth beneath it. As a result, bandwidth limitation now occurs for most sites at the midlevel/regional level rather than at the national network level. While 100 Mb/sec Fiber Distributed Data Interface (FDDI) is supported at some local and regional networks, most have yet to deploy this technology.

Stability period used for tests

A two-week hiatus in December was declared a period of "no change" on the T3 network. The time was used to judge the stability and reliability of the network in a steady state condition, to prepare for the cutover of T1 traffic, to test the T1/T3 interconnect gateway backup, and to perform tests which were scheduled and coordinated with the regional networks. The testing period proved successful and enhanced confidence in the network.

Safety Net

Safety Net has been put in place as a fallback in case all T3 paths to a core node become unusable. It represents the addition of 12 T1 links to interconnect with the T3 backbone Core Nodal Switching Subsystem (CNSS) nodes. These safety net links are in-

See T3 production, *following page*

T3 production, cont. from page 8

stalled between the MCI switching centers and do not connect to the Exterior Nodal Switching Subsystem (ENSS) nodes. The T1 link metrics are designed so that a T1 path is used only if all other T3 paths to adjacent CNSS nodes become unreachable.

Restructuring of Merit/ANS NOC and Internet Engineering Group

The NSFNET is a vital communications link which demands a trouble-shooting structure that is as efficient and reliable as possible. In an effort to produce such a framework the Network Operations Center and Internet Engineering groups have been modified to provide a three-tier problem-resolution setting.

1st Level: Network Operations Technicians. NOC operators will continue to provide first level technical support for network problems. The NOC function will become more formalized with emphasis on reporting, escalation, tracking, and procedure execution.

2nd level: National Network Attack Force. As part of the ongoing efforts to ensure complete trouble-shooting coverage of the national network, the National Network Attack Force (NNAF) has been formed. This group of six individuals provides 24-hours per day/seven-days per week implementation of the T3 network problem resolution process. The team develops NOC diagnostic tools, trains NOC operators, and performs network-related tests. The group reports to the IE manager.

3rd Level: Internet Engineering Group. A number of the tasks indicated above were previously handled by the Internet Engineering staff. As the NNAF members assume those duties, the Internet Engineers will have time to pursue longer-term engineering activities and for attending to the highest priority problems which reach the third level of escalation.

Future T3

The mix of a solid foundation plus future leading edge technology such as the imminent deployment of the new IBM-developed, high-performance interfaces for the RS/6000-based routers, helps ensure that notable network performance will be realized.

As noted on page 10 of this issue, the National Science Board recently approved a request by the National Science Foundation to extend the current Cooperative Agreement with Merit for a period of up to 18 months beyond the November 1992 expiration date of the current contract.

Developers and engineers within the partnership continue to work toward a greater understanding of the interactions of application and network engineering, and to tune the network to maximize efficiency as the user base grows.

— Ellen Hoffman, Mark Knopper, and Pat Smith Merit/NSFNET

The mix of a solid foundation plus future leading edge technology helps ensure that notable network performance will be realized.

NSF Plans for Future Backbone Services

At the end of November 1992, the existing five-year cooperative agreementwhich the National Science Foundation has with Merit for NSFNET backbone services comes to an end. For those who have come to rely on the NSFNET for the work they do in research and education, the question of "what happens next?" is critical to assuring stability and planning for the future.

Some answers are at hand since the National Science Board met at the end of November and approved a plan put forth by NSF's Division of Networking and Communications Research and Infrastructure.

"NSF plans to make a draft solicitation for the Backbone follow-on available sometime in March for a two to three month period of public comment," said Steve Wolff. He added that NSF hopes to issue the solicitation in May or June of this year.

No service interruption for users

The plan has two aspects: the first is a provision which will assure that users will see no interruption in service when the current agreement expires. The second is a set of solicitations for longer-term provision of services.

"As an association of network and information service providers, FARNET [Federation of American Research Networks] has endorsed the principles of competition and choice, especially where the market for these services is maturing," said Laura Breeden, Executive Director of FARNET. "We are looking forward to working with NSF on the implementation of its plans for the INREN [Interim National Research and Education Network]."

Plan reflects FARNET recommendations

This past November FARNET submitted a number of recommendations to NSF regarding interregional connectivity after November 1992. The plan reflects some aspects of the FARNET input, as well as the input of many other individuals, federal agencies, and organizations with whom NSF consulted.

A complete copy of the document may be obtained via anonymous FTP to **nis.nsf.net**. The directory is **/nsfnet/news.releases/** and the document to retrieve is:
nsfnet.project.development.plan

—Merit/NSFNET Information Services

New Acceptable Use Policy from NSFNET

The following is a new acceptable use policy for the NSFNET backbone service. Copies are available via anonymous FTP from **nis.nsf.net**. The file to retrieve is: **acceptable.use.policies/nsfnet.txt** or **nsfnet.ps** for the PostScript version.

The NSFNET Backbone Service Acceptable Use Policy

GENERAL PRINCIPLE:

(1) NSFNET Backbone services are provided to support open research and education in and among US research and instructional institutions, plus research arms of for-profit firms when engaged in open scholarly communication and research. Use for other purposes is not acceptable.

SPECIFICALLY ACCEPTABLE USES:

(2) Communication with foreign researchers and educators in connection with research or instruction, as long as any network that the foreign user employs for such communication provides reciprocal access to US researchers and educators.

(3) Communication and exchange for professional development, to maintain currency, or to debate issues in a field or subfield of knowledge.

(4) Use for disciplinary-society, university-association, government-advisory, or standards activities related to the user's research and instructional activities.

(5) Use in applying for or administering grants or contracts for research or instruction, but not for other fundraising or public relations activities.

(6) Any other administrative communications or activities in direct support of research and instruction.

(7) Announcements of new products or services for use in research or instruction, but not advertising of any kind.

(8) Any traffic originating from a network of another member agency of the Federal Networking Council if the traffic meets the acceptable use policy of that agency.

(9) Communication incidental to otherwise acceptable use, except for illegal or specifically unacceptable use.

UNACCEPTABLE USES

(10) Use for for-profit activities (consulting for pay, sales or administration of campus stores, sale of tickets to sports events, and so on) or use by for-profit institutions unless covered by the General Principle or as a specifically acceptable use.

(11) Extensive use for private or personal business. This statement applies to use of the the NSFNET Backbone only. NSF expects that connecting networks will formulate their own use policies. The NSF Division of Networking and Communications Research and Infrastructure will resolve any questions about this Policy or its interpretation.

Rover—Tooling Up for the Expanding Internet

Owing to the leading-edge nature of the NSFNET technology, appropriate monitoring and diagnostic tools are generally not commercially available.

Getting the "right tool for the job" no longer applies only to obtaining the latest battery-powered gizmo from the local "Hammers R Us" hardware store. The value of owning the proper tool holds true for the "net ops" who manage today's rapidly growing computer networks as much as for carpenters, electricians or auto mechanics.

Since 1988, Merit has operated a Network Operations Center (NOC) in Ann Arbor, MI, for managing the NSFNET. Network capacity has expanded more than 700 times and network connections have grown from 170 in July 1988 to more than 4,500 in January 1992. New nodes and links are now being added almost weekly and data traffic has increased from 195 million to over 13 billion packets per month.

It is the job of the technicians in the Merit NOC to monitor this vast network, open trouble tickets for problems that occur, and track them through to closure.

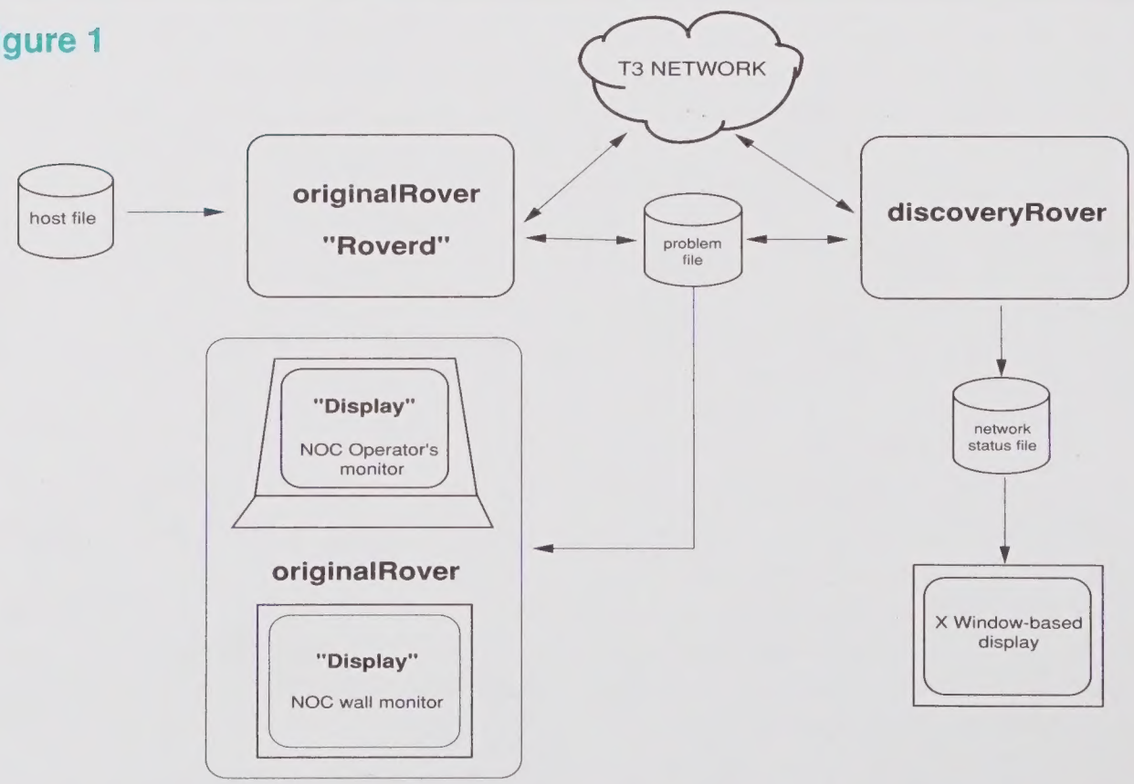
Owing to the leading-edge nature of the NSFNET technology, appropriate monitoring and diagnostic tools are generally not commercially available. Consequently, Merit Internet engineers often write software to fill the need for timely problem detection and resolution on the backbone.

Rover is one of the primary tools used by the Merit NOC to monitor the NSFNET. The Rover package was written by Bill Norton of Merit's Network Management Systems group.

"Bill has had almost daily contact with NOC personnel and has filled in as an

***See Rover**, following page*

Figure 1



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Rover, *cont. from page 12*

operator on occasion. The unique insight into the needs of the NOC gained from this contact is apparent in the design of the tool," said John Labbe, NOC assistant manager.

Rover is an extensible tool that currently incorporates two modules: originalRover, including Roverd and Display, and discoveryRover, which provides an in-depth, real-time picture of the Advanced Network & Services T3 network. Figure 1, at left, illustrates the interactions of the various pieces of Rover.

originalRover

originalRover was developed in 1988. It consists of two parts, Roverd and Display. Roverd reads information from a configuration file called **hostfile** that contains a list of network nodes, IP addresses and associated tests to be performed on each of them. Example lines from hostfile are shown in Figure 2, below.

If the test fails, a problem entry is added to the problem file. Subsequently, if a test succeeds the problem entry is removed. All problem additions and deletions are logged. The contents of the problem file are viewable on monitors through the Display module of originalRover.

Display

The Display module of originalRover allows the contents of the problem file to be viewed on four-by-five-foot monitors in the Merit NOC as well as on the NOC Ops' monitors. The problem file is periodically polled for modifications and the displays are updated accordingly. A representation of the text display is shown in Figure 3 on the following page.

Latest Developments—discoveryRover

During the past months, the T3 ANSnet (Advanced Network & Services network) has come into its own as noted in the article on page 1 of this issue. Rover has been made more robust to deal with the new technology and the increasing complexity of the networks.

Collection mechanism

The initial version of originalRover would cycle through the host file sequentially and the time it took to query all the nodes was somewhat dependent on the state of the network. It would not put a report of "node down" in the problem file until the reachability test—five successive "pings" (five retries, one second apart) had failed. This, plus the sequential pattern, allowed for a potentially high cycle time which was unacceptable.

With discoveryRover it is possible to obtain a more in-depth picture of the network by supplementing the original ping/reachability tests with Simple Network Management Protocol (SNMP) queries.

See Rover, *following page*

Figure 2

```
# Nodename              IP Address      Info              NodeUp? NetMgmtProto
NSF_10_BGP-601-1_/1 192.68.53.2     Help/CAEGP.HLP  PING()
NSF_5->NSF_10       129.140.5.11    Help/LLRT.HLP   PING()  LL(LL/NSS5-NSS10)
NSF_5->NSF_8        129.140.5.12    Help/LLRT.HLP   PING()  LL(LL/NSS5-NSS8)
NSF_5->NSF_12       129.140.5.13    Help/LLRT.HLP   PING()  LL(LL/NSS5-NSS12)
NSF_5->NSF_18       129.140.5.14    Help/LLRT.HLP   PING()  LL(LL/NSS5-NSS18)
NSF_5_spare         129.140.5.15    Help/SPR.HLP    PING()
NSF_5_NEARnet       129.140.5.16    Help/GW.HLP     PING()
NSF_5_NNStat        129.140.5.17    Help/NNSTAT.HLP PING()
```

Rover, *cont. from page 13*

Figure 3

```
originalRover Display v3.32      NOC Internet Rover        Wed Feb 12 17:23 EST
Cycle Time: 01:58 00:23                                    Wed Feb 12 22:23 GMT
                                                                      SSN[  8]
# Reported                Problem                          StatusLine
-------------------------------------------------------------------------------
01  Wed_17:08 NOC_merit.edu 35.1.1.42 TROUBLE
02  Wed_06:14 NSF_10_AS-601 AS_601_Address ASDOWN    tt 18512
03  Tue_17:18 ISIS cnss40-cnss32 DOWN                18504
04  Tue_17:18 ISIS cnss40-cnss41 DOWN                18504
05  Sat_15:59 NSF_4_Test 129.140.4.1 PING            called, no answer
06  Sat_15:59 NSF_2_Test 129.140.2.1 PING            called, no answer
07  Fri_13:03 AS enss136-AS701(Alternet_Network_) DOWtt 18418
08  Fri_16:21 T3_E150_BGP-81-3/3 192.101.21.254 PING disabled by site
```

An X Window-based graphical interface has been developed to aid in using Rover.

30-second discovery of the current topology

Only 30 seconds are needed for discoveryRover to determine the current topology of the network and store the state of the nodes and links in a network status file. This is accomplished by querying the "known" nodes for information on the nodes they know about, i.e. "what links do you have, who is attached to them, and what is the state of the link?" More specifically, SNMP queries return information on node reachability, link state information and information on Autonomous System (AS) reachability.

Nodes that respond to the query are marked up. Link state is determined by querying the IS-IS tables maintained at each of the nodes.

The IS-IS protocol operating over the links and the routers will mark the links **down** if they have not heard a hello packet recently. Conversely, if the router says the link is up, that means it has heard a hello packet and the remote machine is probably up which results in the node being marked busy—most likely up but has not answered the SNMP query yet. Therefore, if SNMP link queries obtain a response then the node at the end of the link is assumed to be functioning and its status is marked **up.**

This discovery process is the mechanism that obtains the information stored in the Network Status File which contains a list of objects named nodes and links. Query responses may be displayed as ordinary text or through an X Window-based environment.

X Window-based display

An X Window-based graphical interface has been developed to aid in using Rover. This "front end" to the Rover data collector displays nodes and links in a color-key fashion which reflects their state as seen in the Network Status File. As new node and link objects are discovered in the network, the map is updated to show the new objects. Placement of nodes on the display is accomplished using the mouse, and the map is automatically saved upon exiting the program.

See Rover, *following page*

Rover, *cont. from page 14*

Customizing

Users can bind arbitrary actions to mouse clicks or key clicks on nodes or links displayed on the map. These actions are defined in the user's .Xdefaults file. The example shown in Figure 4 is a user's .Xdefaults file which binds a "mouse button 1 down event" to opening an AIXterm window and pinging the node in question.

Figure 4

```
Nsfnet3*draw*XmPushButton.Translations: #augment \
<Btn1Down>:      system( aixterm -e ping $1 ) \n\
<Btn3Down>:      system( aixterm -e telnet $1 )
```

The "mouse button 3 down event" is likewise bound to opening an AIXterm window telneted into the node. The graphical display replaces all instances of $1 with the IP Address of the node that was pressed.

The syntax for actions on links is similar. Merit is currently specifying the above tasks in Rover's .Xdefaults file by binding execution of a shell script rather than coding the actual command in the .Xdefaults. While originally done for readability, experience has shown that by executing a shell script, a layer of abstraction can easily be added. For instance, if there is a desire to get connected to a node, the shell script could try to use in-band access first, and if that failed, automatically use out-of-band access transparent to the operator.

One can imagine invoking a link testing shell script with a mouse or key click sequence that would perform link diagnosis. This shell script might query either end of the link for DSU and interface status, error counts, or other defined conditions.

Possible use with other tools

The Network Status File offers another advantage in that it can be used in other network management tools such as statistics collections. The status file provides a list of reachable nodes that is used during the collection of data from the network. As new nodes are discovered they are automatically added to the SNMP data collection list.

An additional feature is the automatic measuring of circuit quality by Merit's DSU circuit monitoring facility as new links are added.

Conceivably, this might permit automatic diagnosis of problems. Binding execution of a shell script to a node or link state transition would be one way of automating problem determination. This script could potentially update the operators' problem entry with the information that it discovered. Eventually, the problem might also be corrected automatically. In that case, the NOC would be informed of the occurrence and the corrective action taken.

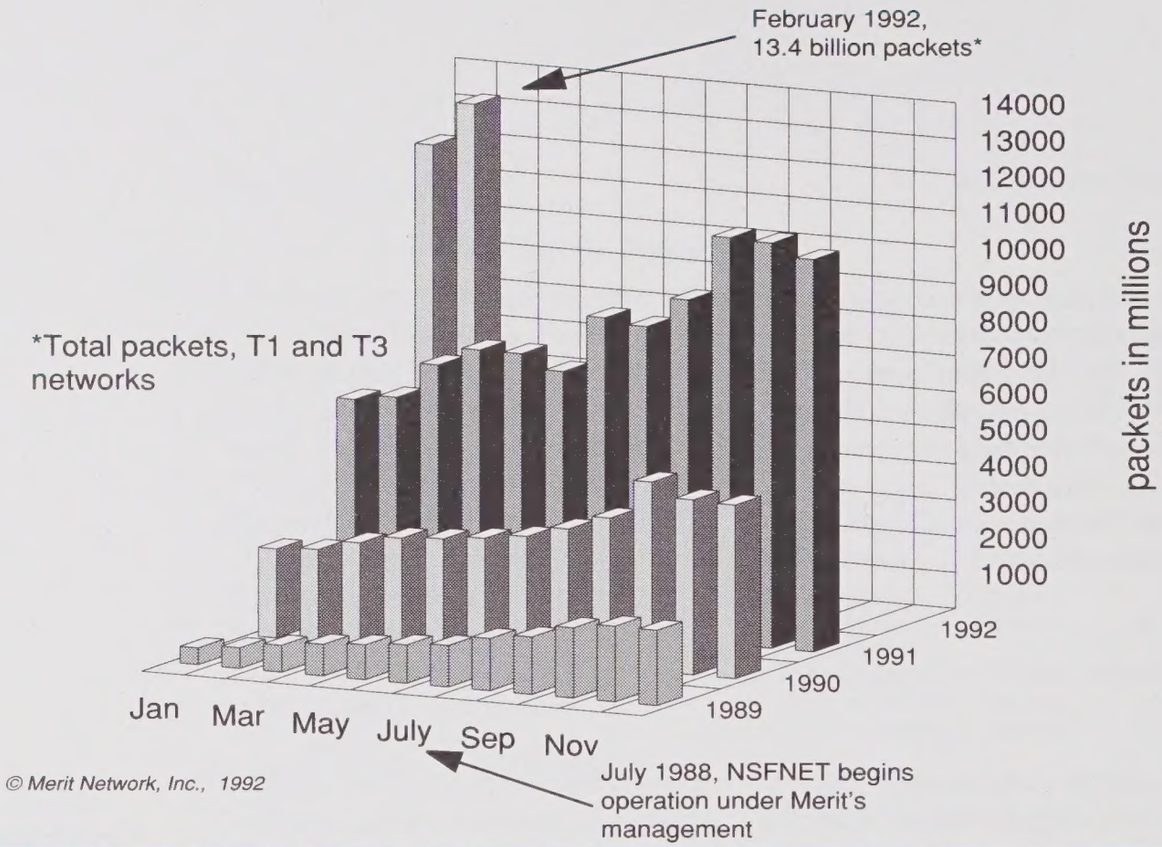
Rover is continually being refined to stay abreast of the current needs of the Network Operations Center. For further information on this tool contact:

Bill Norton
Merit Network, Inc.
1071 Beal Ave.
Ann Arbor, MI 48109-2112
wbn@merit.edu

—Pat Smith, Merit/NSFNET

Users can bind arbitrary actions to mouse clicks or key clicks on nodes or links displayed on the map.

NSFNET Packet Traffic History



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The Merit/NSFNET Project

LINK LETTER

Information — *the commodity of the future*

Names such as Gopher, World Wide Web, Archie, Prospero, and WAIS, which once-upon-a-time may have evoked images of small furry animals and comic strip characters are rapidly gaining "household word" status among users of the Internet. These tools to help users find information on the network have spread from embryonic testing to widespread implementation in little more than a year.

To keep up with the demand for better access to information, Merit/NSFNET Information Services has upgraded its on-line information service by moving to an AIX-UNIX™ based server and implementing WAIS and Gopher to help users navigate files about NSFNET, NREN, and the Internet. File directories have also been reorganized to make it easier for Anonymous FTP users to locate specific information while maintaining e-mail access to documents as in the past.

Collaboration with other groups

In addition to these services, Merit is working with other groups to provide new network information services, including the TopNode project with the Coalition of Networked Information (CNI) and Indiana University (see page 7), with EDUCOM on an X.500 directory of K-12 individuals interested in network applications for teaching and with the IETF user-doc working group to implement a directory on introductory documentation. Merit is also exploring a cooperative project with the University of Michigan to build on the U-M software archives and improve access to these application programs which are widely copied by users throughout the world.

The new services being offered by Merit build on the earlier on-line systems which were based on an IBM 4381 mainframe running the CMS operating system implemented early in the NSFNET backbone project in 1988 (nis.nsf.net). This system made it possible to get information about NSFNET through Anonymous FTP and e-mail.

Types of information expanded

The new services, now implemented on an IBM RS/6000™ running AIX and provided by IBM, continue the existing services while also making it possible to use Gopher and WAIS to search the archives. In addition to running these new tools, the types of information have been expanded to include new directories aimed at providing information for new users. Directories for internet-drafts, and meeting minutes of the IESG and Working Groups of the IETF are shadowed. Merit's server makes it easy to do "one-stop shopping" for information about networking when accessing nic.merit.edu.

Directories and abstracts

Abstracts for each directory and a brief description of files in each sub-directory are found in INDEX files included at each level.

See Information, page 8

September/October '92 — Vol. 5 No. 2

INSIDE:

2 Merit seminar
3 Phase 3 upgrade to T3 network
4 NSF Plans for higher speed backbone
6 Computers, kids, and seniors
7 TopNode update
11 Merit's Cruise of the Internet

This newsletter is printed on recycled paper

Merit Seminar Scheduled for October 19–20 in Ann Arbor

An optional half-day, hands-on tutorial will be available. . .Staff will introduce participants to the tools of the Internet including WAIS, archie, and Gopher.

Once again the opportunity to learn more about the Internet and the many resources available through the NSFNET backbone service is at hand. A Merit/NSFNET seminar plus an optional, hands-on tutorial will take place October 19 and 20, 1992, in Ann Arbor on the campus of the University of Michigan.

This seminar is one in a continuing series put on by Merit to help network users better understand NSFNET and the Internet. Merit's seminars are nationally known for their high quality and the experts who participate. These seminars bring together computing center directors, network developers and administrators, information support specialists, librarians, teachers, and others who need to know the latest about networking for their institutions.

Participating Experts

Mike Roberts of EDUCOM, will give an "NREN Update" as the keynote address. "Internetworking Futures" will be the closing remarks of Douglas E. Van Houweling, UM Vice-Provost for Information Technology. Tom Grundner, President of National Public Telecomputing Network Cleveland Free-Net; Phill Gross, ANS and chair of the IETF; Karen Drabenstott, UM School of Information and Library Studies; and Clancy Wolf, UM School of Education Interactive Communications and Simulations program, will share their expertise.

Hands-on Tutorial

An optional three-hour, hands-on tutorial will be offered immediately following the seminar from 2:30 to 5:30 pm on Tuesday, October 20, for an extra fee of $79. During the class, experienced Merit staff will introduce participants to the tools of the Internet including WAIS, archie, and Gopher—the latest in friendly user interfaces. Space is limited so please register early to guarantee a place. Scholarships will not be given for the tutorial.

The seminar registration fee is $295 until October 5, 1992. After October 5 the cost is $345. This fee includes the one-and-a-half-day seminar, receptions on Sunday and Monday evenings, lunches on Monday and Tuesday, refreshments, access to Internet-connected computers, and all seminar materials.

For more information you may reach us electronically at **seminar@merit.edu** or by phone at **800-66-MERIT or 313-936-3000**.

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Phase 3 Upgrade to T3 Network Completed

Following the successful deployment of serial interface cards on all T3 routers during May, hardware upgrades at regional sites using FDDI will begin in late August. These modifications will increase performance and enhance the stability of the network.

Since the completion of the May deployment, all of the backbone-connected midlevel networks not previously sending their traffic through the T3 network have been moved. Migration of the remaining agency networks and international interconnections is expected to be completed by the end of August and planning is underway to dismantle the older T1 backbone.

T3 interfaces improve performance

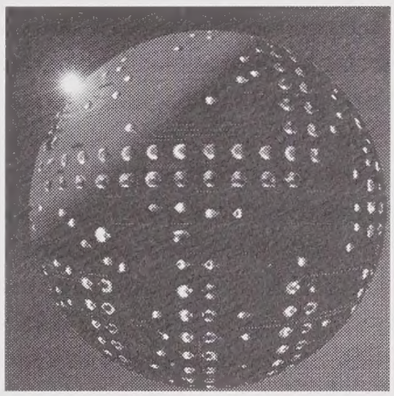
Between April 27 and May 23, the scheduled "Phase III" upgrade to the T3 network took place. All of the T3 adapters, DSUs, RS/6000™ planar boards, and cables were replaced with newer technology.

"The T3 network has been extremely reliable since November 1991," said Mark Knopper, manager of Internet Engineering at Merit. "The RS/960™ upgrade has enhanced network capacity such that the impact of moving the NSFNET traffic from T1 to T3 has been negligible."

The recent hardware upgrade is based upon an adapter technology known as RS/960 which supports on-card packet forwarding to other adapters connected across the IBM RS/6000 microchannel. The RS/6000 host is used as a network controller for route computation and network management. This technology supports up to five T3 interfaces per router. Packet rates over 10,000 pps with 200 bytes/packet and data throughput approaching 22.5 Mbps have been observed in routine testing on the independent ANS/Merit/IBM/MCI T3 test network, where the routers and circuits are configured similar to the production network.

Jordan Becker, Vice President for Network Services at ANS, which provides NSFNET backbone services under subcontract to Merit, noted that appraising router performance is not a straightforward task, and measurements of packets per second alone should not be used to evaluate the routers, or to compare them to other vendors' products:

"Approaching peak throughput on the T3 network requires carefully controlled conditions and applications that are specifically tuned to match the operating characteristics of the network," said Becker. "The performance that is currently observed by individual end users on the T3 network is generally more dependent on local access to the network rather than the high-speed backbone. However, some local networks can already access the backbone at more than 10 Mbps and technologies that achieve greater throughput in these cases are being tested."



Reports from the regional networks have confirmed that the Phase III upgrade went smoothly and successfully.

Extensive monitoring of traffic loads

Merit's Knopper points out that the NSFNET engineering staff performs extensive monitoring of traffic loads and peaks, routing table integrity, and other factors contributing to observed performance. "Any problems causing performance degradation are quickly identified and corrected. The staff also assists regionals in identifying problem sources which occur external to the backbone," he stated.

Users should contact their network administrators if performance problems are suspected in any part of the Internet. "There

See Phase 3, page 12

NSF Plans for Higher Speed Backbone in 1994

As proposed, the Network Access Points will be open to any network service provider meeting specified criteria, and traffic interchange will not be restricted by an acceptable use policy.

The National Science Foundation currently completed a comment period on its plans for the next phase of the NSFNET. In a draft solicitation released in June, NSF proposed a new program that will replace the current T3 (45 Mbps) backbone services with a 155 Mbps backbone, implement connection points among commercial and research and education network providers (Network Access Points or NAPs), and create a new routing entity, optionally available to providers connected at each NAP, to manage traffic exchanges.

vBNS projected for spring 1994

The very high speed Backbone Network Services (vBNS) are currently projected for operation in spring 1994, with a plan in place to extend the current T3 backbone for up to 18 months to assure a smooth transition. In addition to backbone services, the solicitation identifies a second project for a Network Access Point Manager and Routing Authority. This will separate services in the new program which are currently all managed under the single cooperative agreement with Merit. In the solicitation, the backbone services and NAP/Routing Manager must be distinct organizations.

As part of the comment process, the National Science Foundation has participated in several workshops, met with many individuals, and set up a mailing list for discussion of the draft solicitation. Comments ended on August 3, 1992 with a final solicitation to be issued in the fall. Proposals from all bidders will be due to NSF by the end of the year if this time schedule is followed.

Commercial access improved

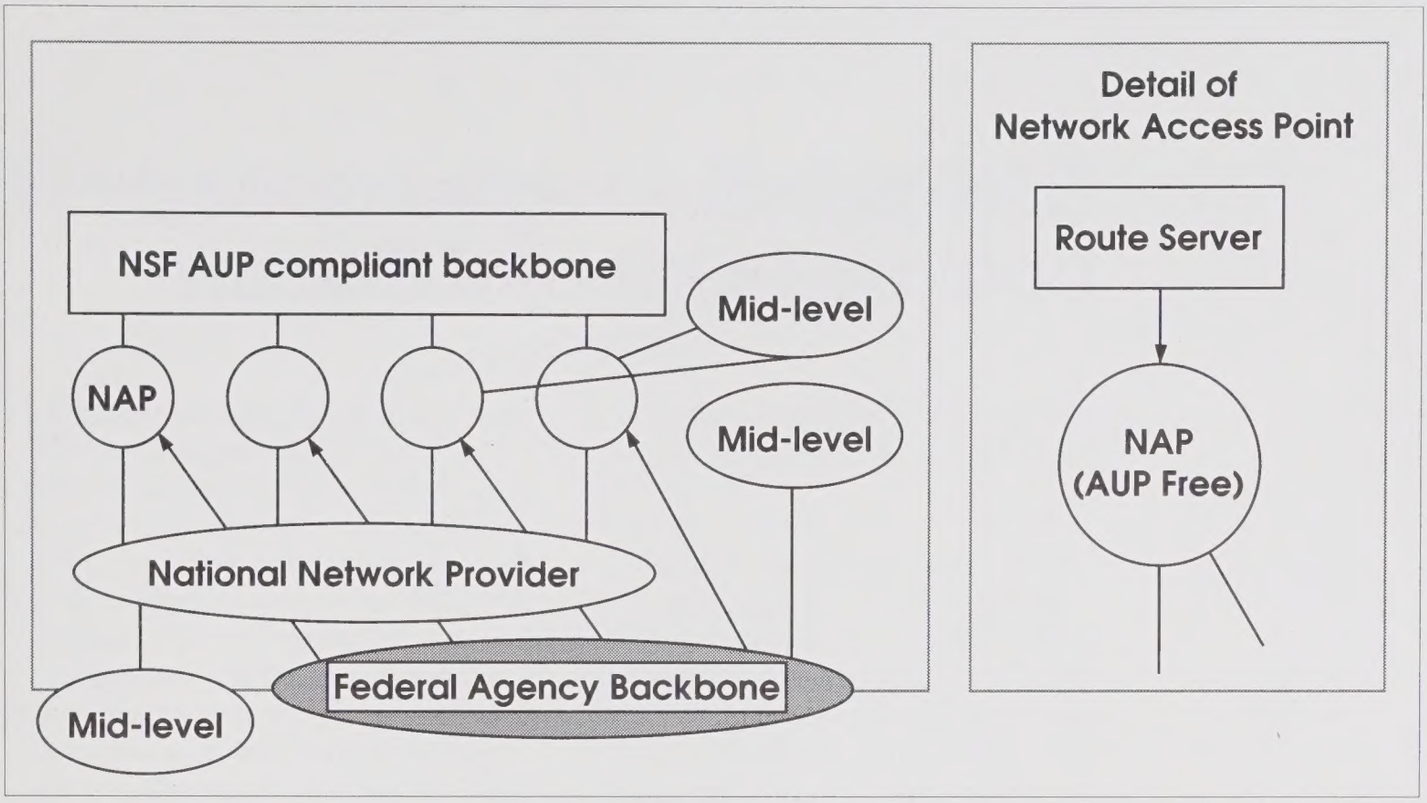
The new program meets the need for Internet connections for multiple providers, including commercial, federal and research and education networks. The NAPs will also provide access for research and education networks to the high speed services, meeting the needs of NSF's primary constituency. As proposed, the Network Access Points will be open to any network service provider meeting specified technical criteria, and traffic interchange will not be restricted by an acceptable use policy. The current plan is for approximately six NAPs, although NSF officials have indicated the actual number could be anywhere from one to twenty in the final solicitation.

By contrast, the vBNS will continue to have an acceptable use policy. Transit traffic will be limited to traffic supporting research and education. The vBNS will be connected to all the NAPs, and regional networks will be able to access it from these points. In addition to pioneering higher performance, NSF has included a specific request for the development of advanced routing technologies such as type of service and procedure routing, the ability to carry both CLNP packets (OSI's Connectionless Network Protocol) and IP (Internet Protocol) packets and provision for real-time multimedia services including multicasting and video teleconferencing.

Regionals also affected

The draft solicitation describes a direct impact on regional networks through a declining subsidy for connections to NSFNET services. The current plan calls for an attachment fee for networks connected to the NAPs, with a goal of having these fees provide a large fraction of the support for the NAP/Routing Manager rather than NSF funding. NSFNET midlevel networks are given the option of connecting directly to a

Continued on following page



Continued from previous page

NAP or to another network service provider which is connected to the NAPs. NSF will support the midlevel's connection for one year, with each midlevel required to find other sources for funding this connection in succeeding years.

Input solicited from FARNET

As part of the comment process, NSF met with regional networks during a workshop sponsored by FARNET (Federation of American Research Networks) on July 9-10 in Boston, MA. During that time, representatives from the regional networks, along with invited guests representing the telecommunications industry and the federal agency networks, proposed several recommendations for revising the solicitation, including a suggestion to separate the NAP Manager from the Routing Authority. The regionals encouraged NSF to move ahead with their plans, focusing on providing a smooth transition to the new services and recognizing that it will have a major impact on the regionals and networking in general.

"What this new plan is *not* is the broad vision of the NREN. Nor is it the general use 'national information infrastructure' that's been talked about," said Robert Aiken, Program Director for the NSF's National Research and Education Network (NREN). "It is primarily for research and education in the sciences. While it may be used by lots of other people and that's good, that's not what this is. This idea may change the way you think about this plan."

Aiken noted that NSF's goals for the plan are to advance the leading edge of network technology and services, increase the ubiquity of network access to the research and education community, and accelerate private sector technology development and deployment.

"There is no way to meet all needs given the dollar figure NSF has—it's not a bottomless budget," said Aiken. He noted that NSF must continue to work with the regionals and others for the success of this project. "We have to get the highest leverage possible, so it must be a team effort."

Solicitation on-line

The draft solicitation is on-line and can be obtained from the Merit information server at **nic.merit.edu**. in the /cise/recompete directory. Several related documents are available in the same directory which give more background on NSF's proposal.

Proposed "very high speed Backbone Network Services" (vBNS)

Computers Bridge the Gap between Kids and Seniors

Ed. note: This article is reprinted from the MichNet News, *Volume 7, Number 2 (June, 1992).*

The idea is to be able to create a biography of the senior's life based solely on information exchanged over the network.

Jan Simms' third grade students at Hickory Grove Elementary School in Bloomfield Hills, Michigan, are as comfortable with telecommunications as most children are with Nintendo. This is a direct result of using an easy-access bulletin board system based in Lansing, practicing on-line communications with another local school, and then incorporating this hands-on experience into an interesting and rewarding class project, writing senior citizens' biographies.

One of the Bloomfield Hills school buildings houses a drop-in center for senior citizens and also has a computer and modem available for their use. The third graders use their classroom equipment to post questions for these seniors on the Lansing bulletin board, and the seniors post answers in the same way. The idea behind the questions is to be able to create a biography of the senior's life based solely on information exchanged over the network.

Seniors, who are sometimes housebound but otherwise healthy, can reach out to a new community of friends using computer networking.

According to Simms, the project with the 'Mature Minglers,' as the seniors' group is known, serves a double purpose. "We were looking for integration of technology fully into the classroom," she explains, "but we were also looking for a way to create a relationship with a very, very important part of our community."

"We have so many single parent families where the kids never see their grandparents. We think it's important for them to have close contact with the older members of our society."

Kids fund phone line for senior partners

The students take this biography writing project very seriously and were frustrated at the slow responses they got from the seniors. Once the students realized that this was not due to lack of interest on the seniors' part, but rather the fact that they had to share a phone line with others in the building, the students took action to remedy this problem.

The third graders held numerous fund-raisers at Hickory Grove, including selling popcorn, and raised enough money to have a dedicated phone line installed expressly for the senior citizens.

Students publish biographies

After compiling all the necessary information, the students use their computers to write and illustrate the biography. They incorporate maps from their geography lessons and produce graphics of themselves for the back cover of the book. At the end of the project, students meet their senior citizens at a party and give them the book they made about their lives. Although they have never actually met, the two groups interact like close friends, sharing smiles and hugs.

"This is the second year we've run the project," says Simms, "and I've just finished downloading all the seniors' information from the bulletin board. It's amazing what these people, men and women alike, have accomplished in their lifetimes."

The rewards of a telecommunication project like this one are an inspiration for others. Networks allow people to communicate who each have much to learn and much to share, even when they are physically separated. Seniors, who are sometimes housebound but otherwise healthy, can reach out to a new community of friends using

***See Kids and Seniors** following page*

Work Continues on TopNode Project

The Coalition for Networked Information (CNI), Indiana University and Merit continue work on TopNode, an Internet directory project. CNI is a consortium formed by American Research Libraries, CAUSE, and EDUCOM to promote the creation of and access to information resources in networked environments in order to enrich scholarship and to enhance intellectual productivity.

Indiana University's responsibilities in the TopNode project include collecting, cataloguing and entering the TopNode data as well as working with CNI to coordinate the project. Merit's responsibilities include sharing knowledge about network resources, assisting in the gathering of such information, and creating an X.500 version of the TopNode directory.

Currently the TopNode participants have defined the data elements for cataloguing directory and application information about Internet resources. Work is now underway to actually implement the catalog, with over 200 resources identified and being described. Work continues on developing a beta version of the TopNode directory.

For further information contact: NSFNET-info@merit.edu or telephone (313) 936-3000.

—Laura Kelleher, Merit/NSFNET

Kids and Seniors,
cont. from previous page

computer networking.

Successful ventures like this one, involving diverse age groups, help dispel the misconception that networks are hard to use. They pave the way for more such creative projects in the future.

Simms and her husband, who teaches in the Waterford school district and who runs a similar project in his classes, will be presenting information about the projects in Washington this spring. They will be taking sample biographies, a video they've made on the project, and other information before two groups, the National Council on Aging and Generations United.

Contact Jan Simms at (313) 540-5287 for more information about this project.

— Alicia Smykla, Merit Network, Inc.

Soviet Papers Available via Anonymous FTP

The Special Projects Office, Library of Congress has announced that the exhibit "Revelations from the Russian Archives" opened June 17, 1992 at the Library of Congress. Those who wish to retrieve selected portions of the documents contained in the exhibit may follow the following instructions.

The README file gives information about the documents available. Continue to transfer files of interest using "get [filename]". Files are in ASCII format and are not very long (no need for compressed files). For those files with the extension .GIF (images of original Russian text) you need some type of GIF viewer. This software is available in the public domain on bulletin boards.

*A sample ftp login is shown below with user input in **boldface** type:*

```
ftp  seq1.loc.gov
Connected  to  seq1.loc.gov
220 seq1 FTP server    ready
Name  (seq1.loc.gov):  anonymous
331 Guest  login ok,  send ident
as  password.
Password:    psmith@merit.edu
230 Guest  login ok,  access
restrictions  apply.
ftp>  cd  pub/soviet.archive
250  CWD  command  successful.
ftp>  get  README
```

Information, *cont. from page 1*

The README file outlines Anonymous FTP and electronic mail query access and presents an overview of the directory structure. Merit/NSFNET Information Services also provides resources on the nic.merit.edu host via electronic mail query. Details for connecting to nic.merit.edu, as well as an overview of the directories, begin on page 9 of this issue.

WAIS at Merit

WAIS (Wide Area Information Servers) allows users to search quickly through terabytes of data from the government, educational institutions, libraries, and other information providers. It is based on the Z39.50 standard for information exchange. Because the protocol is non-proprietary, it is anticipated that many vendors will become involved in providing WAIS services. (See the March/April 1992 issue of the Link Letter for more details on WAIS.)

Obtaining WAIS clients

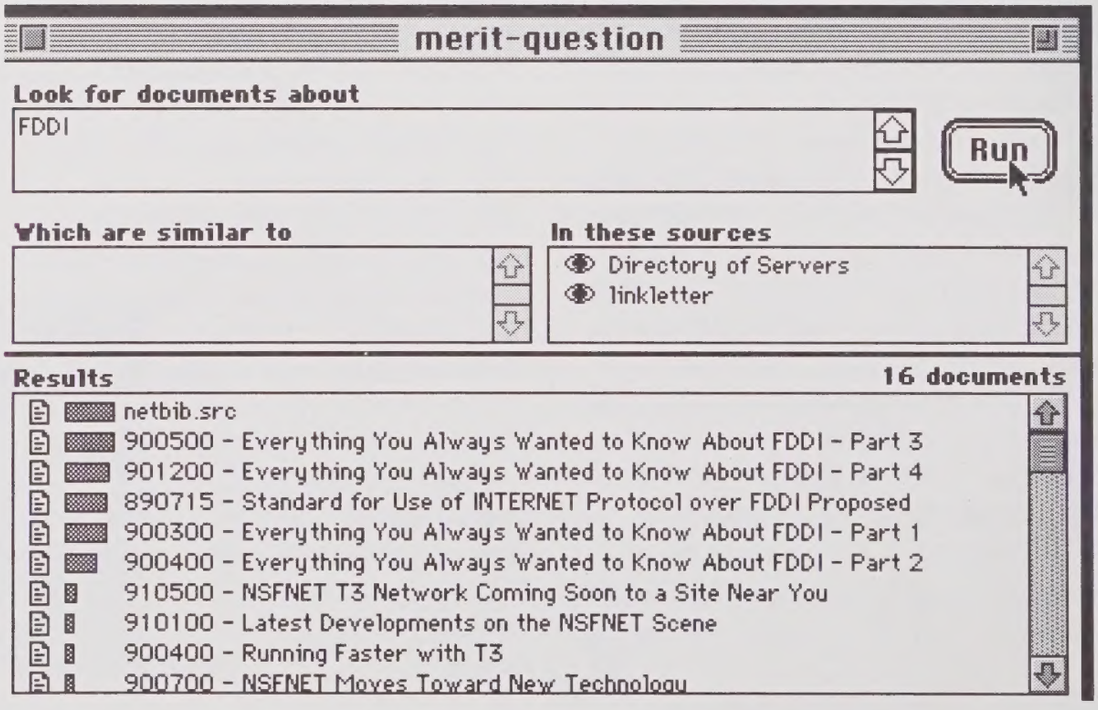
Users may install and run WAIS client software on any desktop computer which is connected to the Internet by TCP/IP. The WAIS software for Macintosh and UNIX machines is available for anonymous ftp from ftp.oit.unc.edu in the pub/wais directory. WAIS software for VMS, DOS, and MS-Windows is at the same ftp site in the pub/wais/UNC directory.

Six databases have been made available on the Merit WAIS server and there are plans for adding more. A WAIS client identifies where servers are and what databases are offered from "source" files.

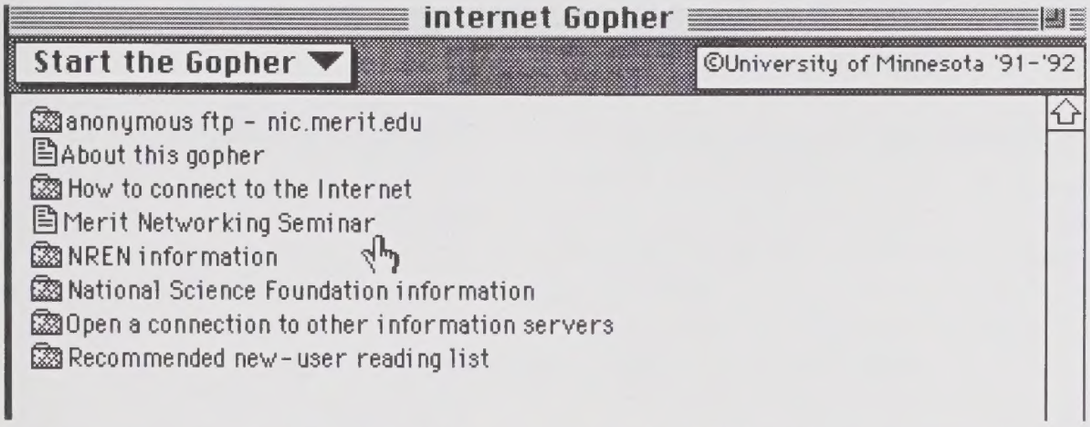
The usual way to obtain these source files is from the "Directory of Servers" on the WAIS server at think.com. (Thinking Machines Corporation is a prime mover in WAIS development). Every WAIS client comes with a source file that can connect to the Directory of Servers. Users can find the

See Information, *following page*

Users may install and run WAIS client software on any desktop computer which is connected to the Internet by TCP/IP.


merit-question
Look for documents about
FDDI
Run
Which are similar to
In these sources
Directory of Servers
linkletter
Results
16 documents
netbib.src
900500 - Everything You Always Wanted to Know About FDDI - Part 3
901200 - Everything You Always Wanted to Know About FDDI - Part 4
890715 - Standard for Use of INTERNET Protocol over FDDI Proposed
900300 - Everything You Always Wanted to Know About FDDI - Part 1
900400 - Everything You Always Wanted to Know About FDDI - Part 2
910500 - NSFNET T3 Network Coming Soon to a Site Near You
910100 - Latest Developments on the NSFNET Scene
900400 - Running Faster with T3
900700 - NSFNET Moves Toward New Technology

Information, *cont. from previous page*



The Merit Gopher server main menu as displayed by the Macintosh Hypercard client. Client software is available for Anonymous FTP from boombox.micro.umn.edu

Merit sources illustrated on p. 8, as well as hundreds of others, in the Directory of Servers.

Further WAIS information

A mailing list features weekly postings on WAIS progress and new releases; to subscribe, send an email note to wais-discussion-request@think.com.

Gopher at Merit

The Merit Gopher server allows for Anonymous FTP access to the wide array of network information on nic.merit.edu. Recent information resources to help the network novice become familiar with the Internet, including its associated networks, resources, and protocols, may be selected from the "Recommended New-User Reading List." "National Science Foundation Information" includes the NSFNET Backbone Services Acceptable Use Policy and current NSF proposals for the Interim Interagency NREN. Connections to other information servers will also be possible.

Individuals can obtain Gopher client software for Mac, DOS, UNIX, VAX/VMS, VM/CMS and other common operating systems via Anonymous FTP to boombox.micro.umn.edu. This client software enables one to access any of the hundreds of Gopher servers on the Internet, including Merit's server on nic.merit.edu.

—Merit/NSFNET Information Services

Directories of interest on nic.merit.edu

acceptable.use.policies/ A directory of policy statements for the acceptable use of the NSFNET backbone and regional networks listed.

cise/ Directory owned by the National Science Foundation's Directorate for Computer and Information Science and Engineering for the placement of NSFNET Backbone Network policy statements and related documents, as well as GAO reports of interest. NSF's Interagency Interim NREN Implementation Plan may be found in the subdirectory **cise/recompete/**.

internet/ Directory devoted to Internet activities: legislative work to promote the NREN, publications on research, experiments and use of the Internet, and available resources, including the subdirectories:

internet/documents/ Publications documenting activity on the Internet, in the realms of education and research by participating organizations.

See Directories*, page 10*

Directories, *cont. from page 9*

internet/documents/fyi/ The FYI (For Your Information) sub-series of Request For Comments (RFCs), designed to provide a wide audience of Internet users with a central repository of information about any topics which relate to the Internet.

internet/documents /iesg/ Minutes of the most recent IETF Steering Group meetings.

internet/documents/ietf/ Current information on Internet Engineering Task Force activities including a general description of the IETF, summaries of ongoing working group activities, and information on past and upcoming meetings.

internet/documents/internet-drafts/ A directory of draft documents which will ultimately be submitted to the IAB and the RFC Editor to be considered for publishing as RFC's.

internet/documents/rfc/ Request For Comments: a document series which describes the Internet suite of protocols and related experiments.

internet/documents/std/ The Standards are the sub-series of notes within the RFC series which document Internet standards.

internet/newsletters/ Includes the Internet.Monthly.Report

internet/resources/ Information on using the Internet and its available resources, including Merit's Internet Cruise.

internet/routing.policies/ Information on routing policies of the networks in the Internet which are usually in the form of ASs (Autonomous Systems).

introducing.the.internet/ A directory providing recent information resources which will help the network novice become familiar with the Internet, including its associated networks, resources, and protocols.

maps/ PostScript maps of NSFNET and MichNet.

nren/ House and Senate activity pertaining to the National Research and Education Network (NREN), including:

nren/hpca.1991/ House and Senate activity leading to passage in 1991 of The High Performance Computing Act.

nren/iita.1992/ House and Senate activity relating to The Information Infrastructure and Technology Act of 1992.

nsfnet/ Archive for administrative, policy and statistical information relevant to the NSFNET Backbone networks, among which are the subdirectories:

nsfnet/engineering.report/ The monthly NSFNET/ANSNET Backbone Engineering Report as published in the Internet Monthly Report.

nsfnet/linkletter/ The Link Letter, a bi-monthly NSFNET newsletter.

nsfnet/resources/ Information files on using the NSFNET and its resources, including Merit's Internet Cruise.

nsfnet/statistics/ Directory of statistical information files collected on the NSFNET Backbone networks. Reports are divided into subdirectories according to the year the data was collected.

Using Anonymous FTP

The resources of nic.merit.edu are available via anonymous FTP (File Transfer Protocol). A sample login is shown below with user input in boldface type.

```
ftp nic.merit.edu
Connected to nic.merit.edu
220 nic.merit.edu FTP server
(Version 4.1) ready
Name (nic.merit.edu:abcd):
anonymous
331 Guest login ok, send
ident as password.
Password:    psmith@merit.edu
230 Guest login ok, access
restrictions apply.
```

Useful ftp commands

dir (directory) displays a listing of the files in the current working directory.

ls (list) command is similar to dir, but provides a brief listing of files in the current working directory.

get initiates the transfer and copies the specified file to a file of the same name on the user's local disk space.

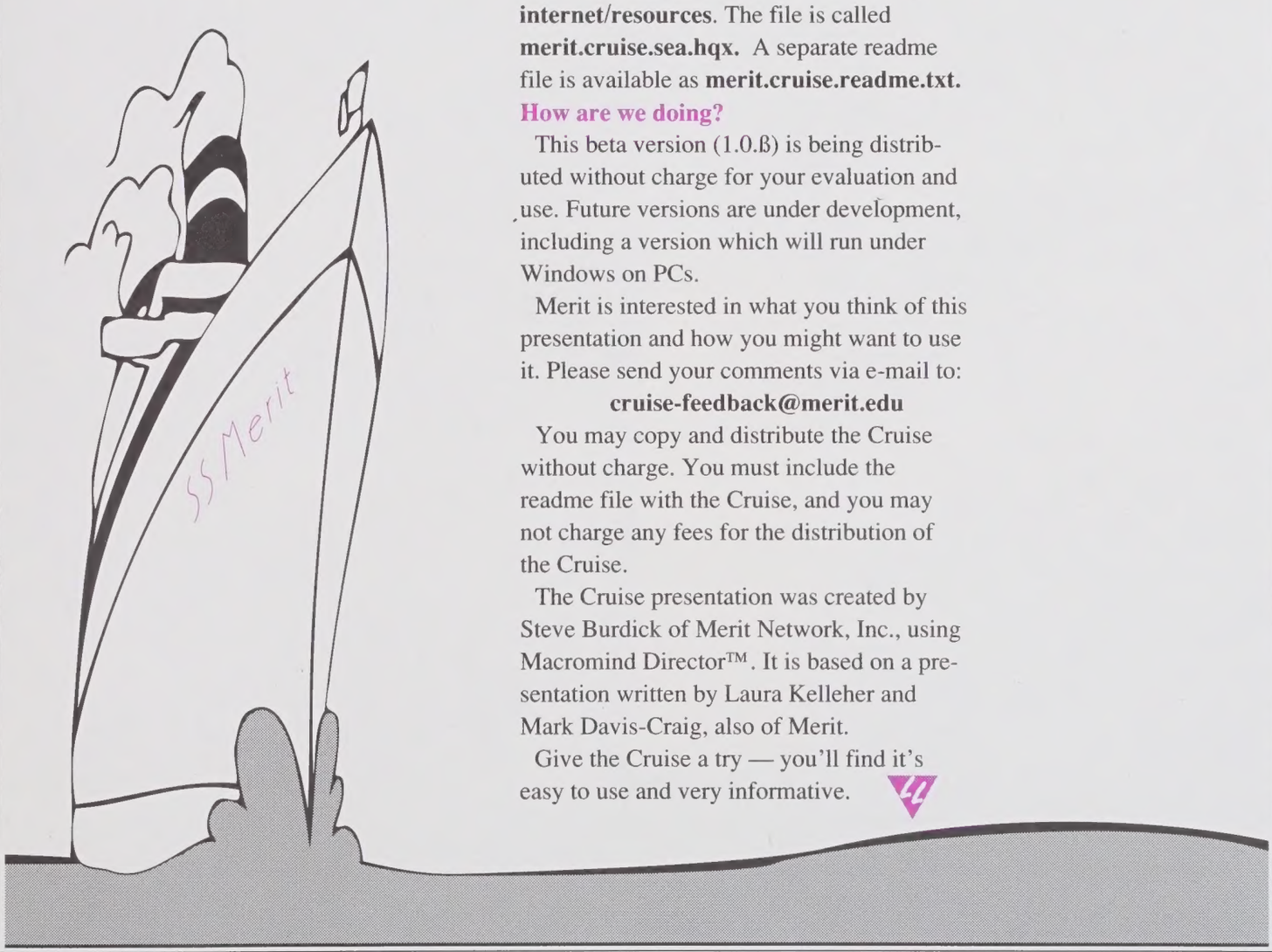
cd (change directory) moves from one directory to another.

For further information on any of these projects at Merit send email to: nsfnet-info@merit.edu or telephone 313-936-3000.

"Won't you let me take you on a sea cruise? "

The Merit staff has developed a colorful desktop cruise that helps new users learn about the Internet and explore its resources. Currently available for the Macintosh, the "Cruise of the Internet" provides an overview of tools and applications found on this international collection of TCP/IP networks.

The Cruise is available via anonymous FTP from **nic.merit.edu** and comes as a compressed, self-extracting file.



The following hardware and software are necessary to take the cruise:

- A Macintosh II™ or Quadra™ series computer
- 8-bit color and any color monitor (13" minimum recommended)
- System 6.05 or 7.x
- Approximately 2 MB of disk space
- 4 MB of RAM is recommended

Get the Cruise via FTP

The Cruise is available via anonymous FTP from **nic.merit.edu** in the directory, **internet/resources**. The file is called **merit.cruise.sea.hqx.** A separate readme file is available as **merit.cruise.readme.txt.**

How are we doing?

This beta version (1.0.ß) is being distributed without charge for your evaluation and use. Future versions are under development, including a version which will run under Windows on PCs.

Merit is interested in what you think of this presentation and how you might want to use it. Please send your comments via e-mail to:

cruise-feedback@merit.edu

You may copy and distribute the Cruise without charge. You must include the readme file with the Cruise, and you may not charge any fees for the distribution of the Cruise.

The Cruise presentation was created by Steve Burdick of Merit Network, Inc., using Macromind Director™. It is based on a presentation written by Laura Kelleher and Mark Davis-Craig, also of Merit.

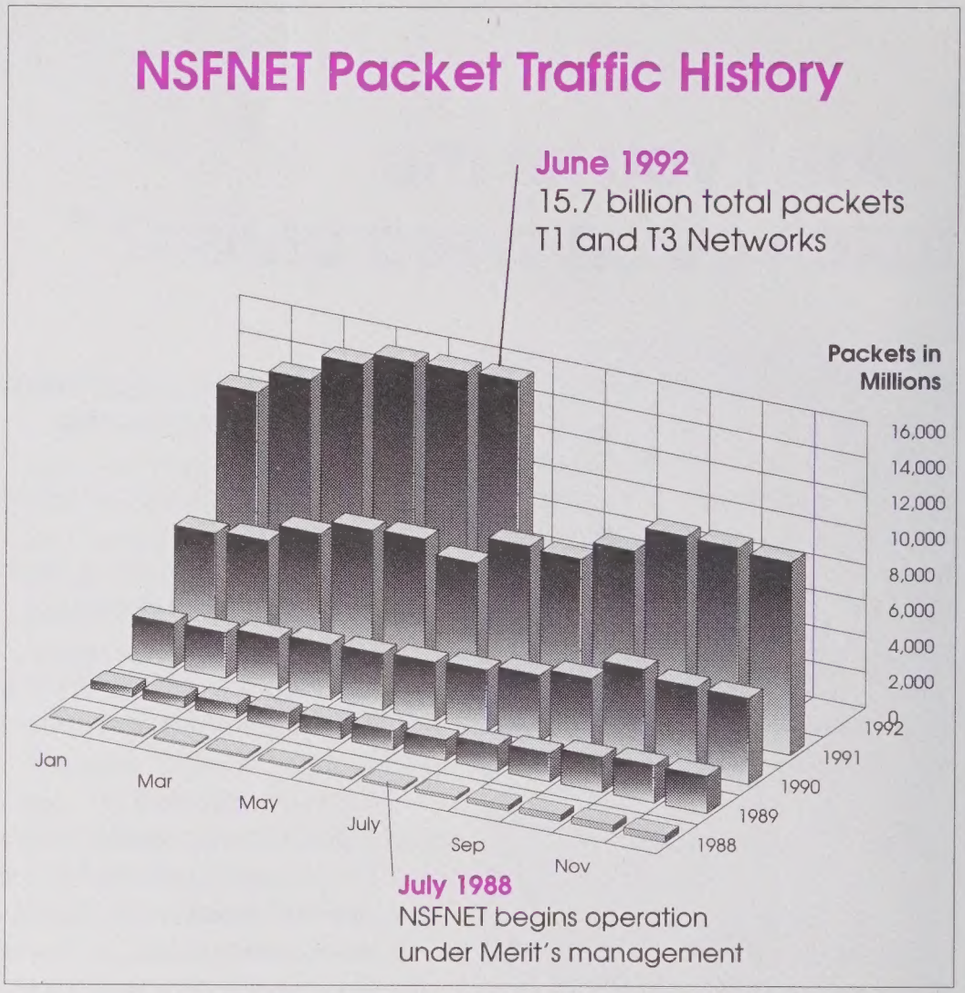
Give the Cruise a try — you'll find it's easy to use and very informative.

Phase 3 *cont. from page 3*

is a high degree of communication among the various network engineers and problems can usually be resolved quickly when reported," Knopper said. "Merit engineering staff will be happy to assist with problems that are difficult to resolve at the local level," he added.

FDDI upgrade scheduled

The throughput that may be achieved by users of the T3 backbone will improve dramatically with the forthcoming FDDI upgrade which is scheduled to begin in August. The process will replace the older FDDI cards with RS/960 FDDI interfaces following extensive testing on the test network. The two-phase plan for the interface replacements reflects a conservative approach to upgrade deployment ensuring continued network stability.



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